U. S. DEPARTMENT OF AGRICULTURE.
BUREAU OF PLANT INDUSTRY—BULLETIN NO. 174.
B. T. GALLOWAY, *Chief of Bureau.*

THE CONTROL OF PEACH BROWN-ROT AND SCAB.

BY

W. M. SCOTT, PATHOLOGIST,

AND

T. WILLARD AYRES, SCIENTIFIC ASSISTANT,

FRUIT-DISEASE INVESTIGATIONS.

ISSUED MARCH 5, 1910.

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PEACHES AFFECTED WITH BROWN-ROT, SHOWING THE DESTRUCTIVE WORK OF THE DISEASE AND THE ROTTEN, MOLDY APPEARANCE OF THE FRUIT.

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Plant Industry,
Office of the Chief,
Washington, D. C., December 15, 1909.

Sir: I have the honor to transmit herewith a manuscript entitled "The Control of Peach Brown-Rot and Scab," by Mr. W. M. Scott, Pathologist in Charge of Orchard Spraying Experiments and Demonstrations, and Mr. T. W. Ayres, Scientific Assistant, Fruit-Disease Investigations, and recommend it for publication as a bulletin of the special series of this Bureau.

The summer spraying of peaches has for years been a puzzling problem on account of the injury to the foliage resulting from the use of various mixtures. After repeated trials a fungicide was found in 1907 in the form of self-boiled lime-sulphur which prevents diseases without injury to the foliage.

The experiments with this material were repeated on a larger scale in 1908. During the past season (1909) the treatment was demonstrated on a block of 5,000 trees and further details were worked out by experiment. The present paper describes these demonstrations and experiments and gives a summary of the three seasons' work, with recommendations for the treatment of orchards.

Respectfully,

B. T. Galloway,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

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THE CONTROL OF PEACH BROWN-ROT AND SCAB.

INTRODUCTION.

The susceptibility of peach foliage to injury from applications of the usual copper fungicides has largely prohibited summer spraying for the control of peach diseases. The diseases preventable by dormant spraying, such as leaf-curl and the California peach blight, have been easily overcome, but those requiring summer treatment have, as a rule, been allowed to go unchecked for the want of a suitable fungicide. The peach has therefore largely had to fight its own battles against some of its worst enemies, with the result that the growers of this fruit have annually sustained heavy losses.

During the past few years the Bureau of Plant Industry has endeavored to develop a fungicide that could be safely used on the peach during the growing season to prevent some of the diseases of the fruit and foliage. Various copper compounds in both liquid and dust form were tested without satisfactory results. Experiments with sulphur in various forms showed that the soluble sulphids were even more caustic than Bordeaux mixture, and no encouragement was obtained from the work until the so-called self-boiled lime-sulphur mixture was tested.

In the experiments of 1907, the results of which were published in Circular No. 1 of the Bureau of Plant Industry,[a] it was found that self-boiled lime-sulphur could be used as a spray on the peach without injury to fruit or foliage. Brown-rot infections were held down to 10 per cent of the crop, while 73 per cent of the fruit on the unsprayed trees rotted. The same treatment prevented the peach scab, or black-spot, and some leaf diseases.

Experiments conducted by the writers during 1908 at Marshallville, Ga., Bentonville, Ark., and Neoga, Ill., verified the previous year's results and gave sufficient data to warrant the recommendation of this mixture for general use in peach-growing districts where brown-rot and scab are prevalent. The results of the 1908 experiments, with suggestions for the treatment of brown-rot and scab, were published in Circular No. 27 of the Bureau of Plant Industry.

[a] These results were first reported by the writer at the Jamestown meeting of the American Pomological Society, September 25, 1907, and were published in the proceedings of that meeting. They were also presented before the Missouri State Horticultural Society, December 5, 1907, by Mr. F. W. Faurot, who assisted in the work.

During the past season (1909) the work on this important problem was carried out on a large scale somewhat in the nature of a demonstration. The results of this work, together with directions for preparing and applying the mixture for the treatment of brown-rot and scab, are presented in the following pages.

The peach grower now has at his command an effective weapon with which to combat two of his worst fungous enemies—brown-rot and scab. In view of the excellent results obtained from the experiments of the past three years, the writers are of the opinion that self-boiled lime-sulphur will soon become almost, if not quite, as indispensable to the peach grower as Bordeaux mixture has been to the apple grower.

PEACH BROWN-ROT.

HISTORY OF THE DISEASE.

The fungus causing brown-rot was first described by Persoon[a] in 1796 as *Torula fructigena*, and he later transferred it to the genus Monilia. In 1893 Schröter[b] placed the fungus in the ascomycetous genus Sclerotinia, although its perfect stage was not known until discovered by Norton[c] in 1902. The fungus is reported by Saccardo[d] as occurring in Great Britain, Germany, France, Italy, Belgium, and Austria, as well as in the United States. Perhaps the first to recognize it as of economic importance were Von Thümen[e] and Hallier[f] and it has been discussed by Frank,[g] Prilleux,[h] Wehmer,[i] Sorauer,[j] Woronin,[k] Aderhold,[l] and other European writers who have contributed largely to our knowledge of the life history of this fungus.

In the United States this disease has been known for many years and has had more or less attention from nearly all the pathologists of this country. In 1881 Peck[m] gave what appears to be the first economic account of the disease, and since that time it has been the subject of study by a large number of investigators, notably Arthur,[n] Gallo-

[a] Observationes Mycologicæ, vol. 1, p. 26.

[b] Kryptogamen Flora von Schlesien, vol. 3, Pilze, p. 67.

[c] Transactions, Academy of Science, St. Louis, vol. 12, no. 8, 1902, pp. 91–97.

[d] Sylloge Fungorum, vol. 4, 1886, p. 34.

[e] Oesterreiches Landwirtschaftliches Wochenblatt, no. 41, 1875, p. 484; see also Fungi Pomicoli, 1879, pp. 22–24.

[f] Wiener Obst- und Garten- Zeitung, 1876, p. 117.

[g] Krankheiten der Pflanzen, 2d ed., vol. 2, 1896, p. 360.

[h] Maladies des Plantes Agricoles, vol. 2, 1897, pp. 449–453.

[i] Berichte der Deutschen Botanischen Gesellschaft, vol. 16, 1898, pp. 298–300.

[j] Berichte der Deutschen Botanischen Gesellschaft, vol. 17, 1899, pp. 186–189.

[k] Mémoires de l'Académie Impériale des Sciences de St.-Pétersbourg, ser. 8, vol. 10, no. 5, 1900, pp. 18–29.

[l] Berichte der Deutschen Botanischen Gesellschaft, vol. 22, 1904, pp. 262–266.

[m] Thirty-fourth Report, New York State Museum, Natural History, 1881, pp. 34–36.

[n] Fourth Report, New York Agricultural Experiment Station, 1886, pp. 281–285.

way,[a] Erwin F. Smith,[b] Humphries[c] and Quaintance.[d] Various other articles dealing principally with the treatment of this disease have appeared in bulletins of the state experiment stations and of the United States Department of Agriculture, and in agricultural journals.

Hygienic measures, such as the removal of rotting and mummied fruits and the pruning out of diseased twigs, have been strongly recommended for the control of brown-rot, and most writers have advised spraying with dilute Bordeaux mixture; but only in rare instances have these remedial measures been successful. In spite of the fact that in a wet season when treatment is most needed Bordeaux mixture and other copper compounds injure peach leaves and defoliate the trees, nearly all the recent publications on the subject have recommended spraying with these fungicides, the authors believing that the benefit would more than counterbalance the injury.

ECONOMIC IMPORTANCE OF THE DISEASE.

With the possible exception of peach yellows, which kills the tree outright, brown-rot has for years been recognized as the most destructive disease of stone fruits, such as peaches, plums, and cherries. It also affects the apple, pear, and quince, but only in rare cases does it become a serious pest on these pomaceous fruits. The disease is well distributed over the United States, and in most of our humid sections it has practically prohibited the commercial production of the European plum and often destroys a large portion of the crops of peaches, Japanese plums, and cherries. The average annual loss to the peach growers of this country easily reaches $5,000,000. Quaintance[e] estimated the loss in Georgia for the year 1900 at from $500,000 to $700,000. The number of bearing trees in that State has more than doubled since that time and the brown-rot has not abated in the least, so that a conservative estimate of the loss at the present time with a fair crop of fruit set and under average brown-rot conditions would be $1,000,000; in fact, the writers are convinced that the loss during the past season, with only a third of a crop, almost reached that figure. Similar losses occur in other Southern States, and the more northerly peach districts are by no means exempt. Dr. Erwin F. Smith[f] placed the loss on the Chesapeake and Delaware peninsula

[a] Report, Commissioner of Agriculture, 1888, pp. 349–352.

[b] Journal of Mycology, vol. 5, no. 3, 1889, pp. 123–134; also vol. 7, no. 1, 1891, pp. 36–39.

[c] Eighth Report, Massachusetts Agricultural Experiment Station, 1891, p. 213; also Botanical Gazette, vol. 18, 1893, pp. 85–93.

[d] Bulletin 50, Georgia Agricultural Experiment Station, 1900, pp. 237–269.

[e] Bulletin 50, Georgia Agricultural Experiment Station, 1900, p. 245.

[f] Journal of Mycology, vol. 5, no. 3, 1889, pp. 123–134.

in 1888 at 800,000 baskets (of five-eighths of a bushel), worth $400,000, which he considered a very conservative estimate. The same writer states that the following spring (April and May, 1889) this section experienced an outbreak of the brown-rot on the blossoms and young fruits which destroyed the greater part of the peach crop in four counties, resulting in a loss of at least 500,000 baskets.

Dr. C. P. Clinton [a] reports that in Connecticut "brown-rot of peaches and plums is always present at harvest time, some seasons becoming so prevalent that it sweeps away a large part of the profits in a few days." The same may be said of the prevalence of this disease in Michigan, Missouri, Arkansas, and in other peach-growing States.

In California, Prof. Ralph E. Smith [b] reported that during 1905 and 1906 the brown-rot was "quite abundant and destructive on apricots, some plums, and early peaches, especially near the coast." It has also been reported from Oregon by Prof. A. B. Cordley [c] as causing excessive rotting of plums in 1897 and 1898 and to a less extent affecting peaches.

The effect of this disease does not cease with the fruit growers, but is felt by the transportation companies, the commission men, and the consumers. Although the fruit may be carefully sorted at the packing house and only sound specimens packed, the disease often continues to develop en route to market, especially if the refrigeration is not good. In an orchard where the disease is prevalent, the healthy fruits easily become contaminated through handling by the pickers and packers, and enough moisture develops in the car through the "sweating" of the fruit to germinate the spores. It thus not infrequently happens that peaches from the Southern States reach the market "specked" and must be sold at half the value of sound fruit. The commission man is often blamed by the shipper for the low returns received, when the trouble is really due to brown-rot. On several different occasions the senior writer has been in the New York market when from thirty to over a hundred cars of southern peaches were sold from 2 to 6 o'clock in the morning and 25 to 50 per cent of the fruit from a large number of these cars was found to be affected with brown-rot. In recent years this condition has so often prevailed that the board of health of New York City deemed it necessary to designate a special health officer whose duty is to inspect the fruit as it is unloaded from the cars and prohibit the sale of such as is badly affected with brown-rot. Fruit arriving in poor condition demoralizes the market to such an extent that where 50 cars of sound

[a] Report, Connecticut Agricultural Experiment Station, 1903, p. 286.

[b] Bulletin 184, California Agricultural Experiment Station, p. 248.

[c] Bulletin 57, Oregon Agricultural Experiment Station, pp. 3–5.

peaches may be readily sold at good prices 15 or 20 cars of fruit specked with brown-rot are sufficient to create a "glut" and often bring scarcely enough to pay expenses.

NATURE OF THE DISEASE AND THE FUNGUS CAUSING IT.

Brown-rot is a fungous disease which affects the fruit of the peach, causing it to decay on the trees or en route to market. As already stated, it is caused by a fungus whose botanical name is *Sclerotinia fructigena* (P.) Schröt. Many fruit growers call it Monilia, the name given to the summer stage of the fungus before the perfect form was known. The fungus also attacks the blossoms and twigs, thus often destroying a portion of the fruit crops at blooming time. The diseased blossoms turn brown and become dried, adhering to the twigs for some weeks. The fungus may extend from the dead blossom into the bark, forming a small brown canker which frequently girdles the twig. In low, damp situations, especially in a wet spring, many blossoms and fruit-bearing twigs may thus be destroyed. Some of the green fruits may become affected at any time during the season, and even young peaches half an inch or less in diameter may rot, but as a rule no serious outbreak occurs until the fruit is nearing maturity. It is at harvest time ordinarily that the greatest destruction is wrought.

On the fruit, brown-rot may at first be observed as a small circular brown spot, which under favorable conditions rapidly enlarges, until within two or three days the entire peach goes down in decay. While the spot is yet small, whitish tufts of spore-bearing threads begin to appear. As the spot enlarges, these tufts, arranged more or less in concentric rings, become so numerous as nearly to cover the surface, giving the diseased area a grayish, moldy appearance. (See Pl. I.) Most of the rotten fruit drops to the ground, but a considerable portion of it may shrivel up on the tree and remain attached until the following season. As in the case of diseased blossoms, the fungus may extend from the rotting peaches into the twigs, killing them and thus reducing the prospects of a crop the following year. In a wet season some varieties suffer so badly from twig infections that the trees have the appearance of a pear tree attacked by blight.

The fungus passes the winter in the mummified peaches hanging on the trees, as well as in those that have fallen to the ground. During the spring and summer, especially in wet weather, the fungus in these mummies produces large crops of summer spores for the infection of the new fruit crop. In the mummies on the ground the fungus forms a black leathery sclerotium, which is the foundation of another kind of spore production. In the spring, during the blooming period, small, brown cup-shaped bodies (apothecia), resembling toad-

stools, about one-half inch in diameter, are produced from mummies which have remained on the ground through two winters partially or entirely covered with soil. (See fig. 1.) One mummy may produce ten to fifteen of these bodies, each of which produces myriads of ascospores. When disturbed by a puff of wind a little cloud of spores may be seen to rise into the air from one of the cups. These ascospores, as well as the conidia, serve to infect the blossoms. A crop of summer spores is in turn produced on the diseased blossoms and some of the young, green fruits become infected by these, so that there is usually a great abundance of material ready for the infection of the mature crop of fruit, even if the old mummies have been removed from the trees.

FIG. 1.—An old brown-rot mummy with the cup-shaped bodies (apothecia) of the fungus, in which myriads of ascospores are produced.

It has for years been recommended that the rotten fruit be picked from the trees and from the ground and destroyed in order to remove the source of infection for the following year's crop. This is a good practice, but it is usually disappointing, because the fungus is so prolific in spore production that the few mummies that inevitably escape the pickers are sufficient to furnish the initial infection material for the entire crop of the following year. Protection of the fruit by spraying appears to be the only satisfactory means of combating this fungus, although the destruction of diseased fruits doubtless aids in checking it and should not be discouraged.

INFLUENCE OF THE WEATHER.

Most parasitic fungi are influenced by weather conditions. This is especially true of the brown-rot fungus. Moisture not only favors the growth of the fungus and the production and germination of the spores, but it also renders the fruit tender and watery and therefore more susceptible to rot. In a dry season, or one with only occasional rains of short duration, a peach crop may be expected to reach maturity practically free from rot, particularly if the weather is cool; but when

a series of cloudy days with frequent showers occurs about picking time, half or even all of the crop may be destroyed by brown-rot. Prolonged cloudy, drizzly weather, even though the precipitation may not be great, is far more dangerous than a heavy rain followed by clearing. Hot weather also favors the rapid growth of the fungus and increases the danger of its destroying the crop.

INFLUENCE OF INSECTS.

The spores are undoubtedly distributed broadcast by the wind, so that they are in most cases ever present on the fruit ready to produce an outbreak of the disease when the conditions are favorable. Although the fungus appears to be able to enter the peach through the unbroken skin, entrance is more readily accomplished through abrasions such as are made by insects and through cracks due to the scab fungus. Sucking insects of the squash-bug family (Coreidæ) have been observed to puncture healthy and diseased fruits indiscriminately,[a] thus not only distributing the spores but probably inserting them into the peach. But the curculio is by far the worst offender. It breaks the skin of the peach and leaves a wound through which the fungus readily gains entrance. Although the wound may apparently heal before an outbreak of rot occurs, an exudation of gum often keeps it open sufficiently to admit the fungus. The work of this insect greatly reduces the efficiency of fungicides applied for the control of brown-rot. It punctures the fruit through the coating of spray, possibly inserting brown-rot spores and certainly leaving an opening for the fungus. In experiments conducted by the Bureau of Plant Industry in cooperation with the Bureau of Entomology it was found that 93 per cent of the brown-rot infections on sprayed fruit had taken place through curculio punctures. It is evident, therefore, that in order to secure the best results from spraying for brown-rot, the curculio must also be controlled.

PEACH SCAB.

CHARACTER OF THE DISEASE.

Peach scab is a disease caused by the fungus *Cladosporium carpophilum* Thüm. It is also known as black-spot, and peach growers often call it "freckles," which is an appropriate name, owing to the freckled appearance the disease gives to the fruit. The spots are dark brown or blackish, circular in outline, and about one-eighth of an inch or less in diameter. They are often so numerous that one side of the peach has a "smutty" or blackish appearance, cracks open, and shrivels. (See Pl. III, figs. 1 and 2.)

[a] Scott and Fiske. Bulletin 31, Division of Entomology, U. S. Dept. of Agriculture, p. 29.

The disease mars the appearance of affected fruit, reducing its market value and often rendering much of it unsalable. The large cracks which occur in severe cases open the way for brown-rot, and in addition the skin under the individual spots is usually broken, exposing the peach to attacks of the fungus. Preventing the scab is therefore an important step in the control of brown-rot.

The fungus forms brown spots on the twigs where it passes the winter. So far as is known at present, these twig spots are the chief source of infection of the fruit. Fruit infection begins to take place about three to four weeks after the petals fall, although the spots do not show until about three weeks later. Infections continue to take place until about a month before the fruit matures.

ECONOMIC IMPORTANCE OF THE DISEASE.

Peach scab has been known in this country for many years, and it occurs to an injurious extent wherever peaches are grown east of the Rocky Mountains. The damage done by this disease is apparently not fully realized by peach growers. Scab spots are so common on the peach that most of the eastern growers have come to take the disease as a matter of course and scarcely realize that their fruit is bringing 25 per cent less in the market than the same fruit free from scab would bring. Moreover, the fungus has a tendency to dwarf the fruit and prevent it from attaining full size, so that a considerable loss in yield is thus sustained.

On the other hand, some growers recognize it as their worst enemy, and in many localities it practically prohibits the growing of certain varieties. Some of the large orchards in the mountains of West Virginia and western Maryland have sustained heavy losses from this disease, and the growers have been obliged to confine their plantings of such late varieties as Bilyeu and Salway to the high ridges in order to avoid scab. The Bilyeu is very valuable commercially, but the scab has restricted its successful production to the higher points.

It has been known for some years that peach scab could be controlled by applications of Bordeaux mixture, but its use for this purpose has been discouraged by its injurious effects upon peach foliage. The disease has therefore been practically without a satisfactory remedy.

SPRAYING FOR THE CONTROL OF PEACH BROWN-ROT AND SCAB IN 1909.

As stated in the introduction of this paper, peach brown-rot and scab were effectively controlled by spraying with a self-boiled lime-sulphur mixture in experiments conducted during 1907 and 1908. The work of 1907 was confined to small plats in one orchard, while that of 1908 involved several orchards in different localities, aggregating about 2,000 trees.

During 1909, in order to place the treatment on a better commercial basis, large blocks of several different varieties, comprising over 5,000 trees, were sprayed. This was more in the nature of a demonstration than an experiment, although some features of the work were purely experimental, as will be seen in the following pages. In addition to this block, about 7,000 trees in the same orchard were sprayed by the owner under the supervision of the writers.

The work was conducted in the orchard of the Hale Georgia Orchard Company, at Fort Valley, Ga., and the writers are indebted to Mr. J. H. Hale, president of the company, and Mr. J. H. Baird, its superintendent, for their hearty cooperation and valuable assistance. This orchard was in good condition, having been well cultivated, fertilized, and pruned, but in recent years the brown-rot had become exceedingly bad. The crop of 1908 was largely lost on account of brown-rot, scab, and curculio, and the conditions were particularly favorable for a severe test of the self-boiled lime-sulphur treatment. Unfortunately, however, in this orchard, as in most of the Georgia orchards the past season, the crop was very light for all varieties and the yield per tree quite low, but the value of spraying was, nevertheless, strikingly demonstrated.

The spraying was done with a power outfit consisting of a 2-horse-power gasoline engine, a triplex pump, a 200-gallon tank, a propeller agitator, two 25-foot leads of discharge hose, Vermorel nozzles, etc. The mixture was prepared according to the following formula and directions.

PREPARATION OF SELF-BOILED LIME-SULPHUR MIXTURE.

The mixture used in our experiments during the past season was composed of 8 pounds of fresh stone lime and 8 pounds of sulphur (either flowers or flour may be used) to 50 gallons of water. This appears to be about the correct strength, although in mild cases of scab and brown-rot a weaker mixture, containing 6 pounds of each ingredient to 50 gallons of water, may be used with satisfactory results. The mixture can best be prepared in rather large quantities—say, enough for 200 gallons at a time, making the formula 32 pounds of lime and 32 pounds of sulphur, to be cooked with a small quantity of water (8 or 10 gallons) and then diluted to 200 gallons.

The lime should be placed in a barrel and enough water poured on to almost cover it. As soon as the lime begins to slake the sulphur should be added after first running it through a sieve to break up the lumps. The mixture should be constantly stirred and more water added as needed to form a thick paste at first and then gradually a thin paste. The lime will supply enough heat to boil the mixture several minutes. As soon as it is well slaked, water should be added

to cool the mixture and prevent further cooking. It is then ready to be strained into the spray tank, diluted, and applied.

The stage at which cold water should be poured on to stop the cooking varies with different limes. Some limes are so sluggish in slaking that it is difficult to obtain enough heat from them to cook the mixture at all, while other limes become intensely hot on slaking and care must be taken not to allow the boiling to proceed too far. If the mixture is allowed to remain hot fifteen or twenty minutes after the slaking is completed, the sulphur gradually goes into solution, combining with the lime to form sulphids, which are injurious to peach foliage. It is therefore very important, especially with hot lime, to cool the mixture quickly by adding a few buckets of water as soon as the lumps of lime have slaked down. The intense heat, violent boiling, and constant stirring result in a uniform mixture of finely divided sulphur and lime, with only a very small percentage of the sulphur in solution. The mixture should be strained to take out the coarse particles of lime, but the sulphur should be carefully worked through the strainer.

SELF-BOILED LIME-SULPHUR TREATMENT AND RESULTS.

Several different varieties of peaches were sprayed with good results. The details of the work were about the same in each case, the following notes on the Waddell variety serving as an example of the treatment given and the results obtained:

Plat 1, consisting of 568 Waddell trees, was sprayed with self-boiled lime-sulphur (32-32-200) on April 30, about one month after the petals dropped, and again on May 20, three to four weeks before the fruit ripened. At picking time the entire crop, including dropped fruit from five average trees in this plat, was sorted and counted, with the result that 17 per cent was found to be affected with brown-rot. An examination of the rotting fruits showed that 93 per cent of the infections had taken place through curculio punctures and that aside from such infections only 1 per cent of the crop was affected with brown-rot.

From a commercial standpoint, the scab or black-spot was completely controlled, although 16 per cent of the fruit showed some slight infections. None of the fruit was sufficiently spotted to injure its market value.

Check A consisted of 1,357 unsprayed Waddell trees in a block adjacent to plat 1. Of the fruit from five average trees in this block 49½ per cent was affected with brown-rot and 91½ per cent with scab. About one-third of the scabby fruit, or 28½ per cent of the total crop, was so badly spotted and cracked that it had to be discarded as unmerchantable. In this case 81 per cent of the brown-rot infec-

tions had apparently taken place through curculio punctures. In the actual counts of diseased specimens from plat 1, as compared with the unsprayed plat, there was a difference in favor of spraying of 32½ per cent in the case of brown-rot and 75½ per cent in the case of scab. These figures do not tell the whole story. The sprayed fruit was larger, more highly colored, and presented a much better appearance in the package; it carried to the market in better condition and commanded a higher price than the unsprayed fruit.

Plat 2 was a block of 1,275 Waddell trees sprayed only once to determine the value of a single application. The spraying was done on April 30, a month after the petals dropped. The intention was to make this application at a time when it would be expected to accomplish the best results against scab. The Waddell is one of the worst of the early varieties to scab, and to control this disease is an important step in the control of brown-rot.

The sorting record of the fruit from five trees in this block showed that 32 per cent was affected with scab and 12½ per cent with brown-rot. The percentage of scabby fruit ran rather high, but the spots were mostly small and scattered, so that only 2 per cent of the crop was badly affected. If the disease is kept down to two or three spots on each fruit the damage is very slight even though a large percentage of the crop may be so affected. The unsprayed trees of this variety, as pointed out above, had 91½ per cent of the fruit affected with scab, while 28½ per cent of the crop was so badly spotted with the disease as to be unmerchantable. One spraying, therefore, made a difference of 59½ per cent in the amount of fruit affected with scab and resulted in an actual saving of 26½ per cent of the crop from destruction by scab.

COMMERCIAL RESULTS.

In order to determine the commercial results a record was made of the marketable fruit from each plat. The fruit was brought into the packing house, sorted, and packed in the usual way. The number of trees in each plat varied, ranging from 568 to 1,357, and for convenience of comparison the average yield for 500 trees in each plat is given as follows: Plat 1, 160 crates; plat 2, 170 crates; and the check or unsprayed plat, 80 crates.

This record of yield corresponds closely to the results expressed in percentages of diseased fruit as determined by sorting the crop from five trees in each plat. In such large plats considerable variation in the trees and environment would naturally be expected and there was perhaps a sufficient difference between plat 1 and plat 2 to account for the fact that the latter, which was sprayed only once, had less brown-rot and more good fruit than the former, which was

sprayed twice. The check plat, which lies between plats 1 and 2, certainly represents something near the average conditions for the whole block involved and the difference in yield between the sprayed and the unsprayed trees was, for the most part, undoubtedly due to the effect of the spraying. The application of self-boiled lime-sulphur, therefore, apparently increased the yield by 100 per cent.

SELF-BOILED LIME-SULPHUR AND ARSENATE OF LEAD IN COMBINATION.

It has been known for many years that the curculio is an important factor in the distribution of brown-rot and that to prevent the former would be an important step toward controlling the latter. In our first lime-sulphur experiments during 1907 the interference of this insect with the efficacy of spraying for the control of brown-rot was again clearly brought out. In discussing the results of that year's work the senior writer stated that "the plum curculio punctures the skin of a certain percentage of the fruit and admits the fungus in spite of all spraying that can be done."[a] Although in most of our experiments the brown-rot has been held down by spraying to about 10 to 15 per cent where the unsprayed fruit ran 50 to 70 per cent of brown-rot, it has nevertheless been apparent in all the work that spraying for brown-rot would not be entirely satisfactory so long as the curculio was not also controlled.

Entomologists have known for many years that the curculio could be controlled by the application of arsenical poisons, but owing to the danger of injury to both fruit and foliage they have very properly been cautious about recommending their use on peach trees. Mr. A. L. Quaintance, of the Bureau of Entomology, during the past five or six years, has experimented extensively on the use of arsenate of lead for spraying peach trees, with the result that a high percentage of curculio injury was always prevented by two or three sprayings beginning soon after the petals dropped. In 1905 he recommended with due caution the spraying of peach trees with arsenate of lead for the control of this insect.[b] Mr. E. P. Taylor,[c] of the Missouri Fruit Experiment Station, recently reported that during 1908 he had obtained a high percentage of fruit free from curculio by the use of arsenate of lead, with very little injury to the foliage. He also noted a very marked reduction of brown-rot on the sprayed trees.

In order to test the practicability of combining arsenate of lead with self-boiled lime-sulphur as a combination treatment for scab, brown-rot, and curculio, one of our principal experiment blocks at Fort Valley, Ga., was devoted to this purpose. This work was car-

[a] Circular 1, Bureau of Plant Industry, U. S. Dept. of Agriculture, 1908, p. 16.
[b] Yearbook, U. S. Dept. of Agriculture, for 1905, p. 329.
[c] Journal of Economic Entomology, vol. 2, 1909, p. 156.

ried on in cooperation with Mr. Quaintance. A block of 2,324 Elberta peach trees, 7 years old, was selected for this test and nearly half of it sprayed, the remainder being left unsprayed as a check. The results of the treatment were exceedingly satisfactory, as will be seen in the following notes.

The treated portion, designated as plat 6, consisted of 1,100 trees, not quite half of the block. These trees were sprayed as follows:

(1) With arsenate of lead, 2 pounds to 50 gallons of water, on March 31, as the dried calyces (or shucks) were shedding. This application was intended for the curculio only, and as the date was too early for serious brown-rot and scab infection the lime-sulphur was omitted.

(2) With 8–8–50 self-boiled lime-sulphur and 2 pounds of arsenate of lead combined, on April 22, three weeks after the first treatment.

(3) With self-boiled lime-sulphur alone, on May 21.

(4) With self-boiled lime-sulphur alone, on June 9, about one month before the fruit ripened.

The curculio treatment necessitated an extra application before the time to begin using the fungicide, thus increasing the cost. However, the cost of materials, labor, and teams for these four sprayings was only $62.38, or 5⅜ cents for each tree. Moreover, the writers are of the opinion that only three applications, as outlined below, will be required to secure satisfactory results, thus reducing the cost. The trees were watched closely throughout the season and no injury to fruit or foliage was observed.

When the mature fruit, including windfalls, from five average trees in this plat was sorted and counted, it was found that only 4½ per cent was affected with brown-rot, about half of which apparently resulted from curculio punctures. Only 6½ per cent of the fruit showed scab infections, and these were mostly small, obscure specks. The curculio infestation was 27½ per cent of the crop.

The check was composed of 1,224 unsprayed Elberta trees adjacent to the sprayed block. The trees in the two blocks were of the same age and were growing under the same conditions of soil, cultivation, etc., the only difference being that one block was sprayed and the other was not. The fruit from five of the unsprayed trees when sorted proved to be 63 per cent rotten, 99 per cent scabby, and 97½ per cent wormy from curculio. In other words, the crop was practically a total loss. A comparison of these figures with those of plat 6 (the sprayed part) shows that spraying saved 58½ per cent of the crop from brown-rot, 92½ per cent from scab, and 70 per cent from curculio.

COMMERCIAL RESULTS.

A record kept in the packing house showed that the sprayed block of 1,100 trees yielded 327¼ crates of first-class fruit, while the unsprayed block of 1,224 trees yielded only 33¾ crates, all of which were poor in quality. At the beginning of the season the set of fruit

appeared to be about equal in the two blocks, but was very light in both. So far as could be determined, the difference in yield was due entirely to spraying. It appears, therefore, that in the combined self-boiled lime-sulphur and arsenate of lead spray we have an effective remedy for the peach scab, brown-rot, and curculio, the yield from the sprayed trees in this instance being ten times that from the unsprayed trees.

MARKETING TEST.

In order to determine the carrying quality and market value of the sprayed as compared with the unsprayed fruit, two cars of peaches from the experiment blocks were shipped to New York, examined on arrival, and sold in the usual way through a commission house. This test was accomplished through the cooperation of Mr. Hale and the Georgia Fruit Growers' Exchange.

The fruit for the first car was picked on Friday, July 9, in a drizzling rain, but was not loaded and billed out until the following day. It was due on the New York market the following Tuesday morning, but was delayed en route and was not sold until Wednesday morning, July 14. This car contained Elberta peaches from the lime-sulphur–arsenate-of-lead block and from the adjacent check block, Belle peaches sprayed three times with lime-sulphur alone, and unsprayed Belles. The market was almost glutted with poor fruit and the prices were at about the lowest point of the season. The fruit was sold at the following prices:

Sprayed Elbertas	$2.00 per crate.
Unsprayed Elbertas	1.50 per crate.
Sprayed Belles	1.25 per crate.
Unsprayed Belles	1.12½ per crate.

The fruit of the second car was picked on Monday, July 12, and was sold on Thursday morning, July 15. This car contained Elbertas sprayed twice and Belles sprayed three times with the self-boiled lime-sulphur; also unsprayed fruit of both varieties. The fruit of this car brought the following prices:

Sprayed Elbertas	$1.45 per crate.
Unsprayed Elbertas	1.25 per crate.
Sprayed Belles	1.50 per crate.
Unsprayed Belles	1.14 per crate.

In the first car the difference in favor of the sprayed fruit was 50 cents a crate for Elbertas and 12½ cents a crate for Belles. In the second car it was 20 cents a crate for Elbertas and 36 cents a crate for Belles. An examination of several crates of Elbertas showed that 34 per cent of the unsprayed fruit was specked with brown-rot, while only 6 per cent of the sprayed fruit was so affected. (See Pl. II.) This difference in market value was due to the fact that the sprayed fruit showed less rot, was more highly colored, and had a better ap-

pearance in all respects than the unsprayed fruit. Another significant fact is that in each case all the sprayed fruit was sold before the buyers began purchasing the unsprayed fruit, showing that they readily recognized the superiority of the former. This marketing test indicates that the enhancement in the market value of sprayed fruit would pay the cost of the work several times over.

COST OF THE TREATMENT.

As previously stated, the spraying was done with a gasoline-power outfit of 200-gallon capacity. Three men operating the machine sprayed 900 to 1,000 trees a day. The mixture was prepared in quantities of 32 pounds of lime and 32 pounds of sulphur in a barrel with a small quantity of water, then strained into the spray tank or a supply tank, and diluted to 200 gallons. When the blocks farthest from the mixing platform were being sprayed, a 200-gallon supply tank was used to haul the mixture to the spraying outfit so as to keep the machine in operation and avoid delay as much as possible. One man was required at the mixing station to prepare the mixture, but his time was not entirely occupied in keeping the spraying outfit supplied. In fact, one man should be able to prepare the mixture rapidly enough for five or six spraying outfits.

The quantity of mixture required for each thousand trees varied with the size of the trees. Medium-sized 7-year-old Elberta trees required about 1,400 gallons per thousand for each application. To make that quantity, 224 pounds of sulphur and the same weight of lime were required. The block sprayed with arsenate of lead required 32 pounds of the poison in the first application (when the foliage was scant) and 56 pounds in the second application for each thousand trees.

The price of materials and labor used in the work at Fort Valley, Ga., was as follows: Sulphur (flour), $2.85 per hundred pounds; lime, $1.10 per barrel; arsenate of lead, 12 cents a pound; gasoline, 13 cents a gallon; team (pair of mules), $2.75 a day; and labor, 75 cents a day.

At the above prices the cost of the self-boiled lime-sulphur treatment was $1\frac{1}{8}$ to $1\frac{3}{8}$ cents per tree for each application, or an average of $4\frac{1}{8}$ cents per tree for three treatments. The combination lime-sulphur–arsenate-of-lead treatment cost $5\frac{3}{8}$ cents per tree for four applications. Where labor is higher and working hours shorter the cost would of course be greater, but in the South, under conditions similar to those existing at Fort Valley, it appears that the work can be done at a cost of $15 per thousand trees for each application, or $45 for three treatments. This cost is insignificant when considered in connection with the fact that an increased yield of 25 to 50 per cent, or in some cases 100 per cent, may be expected from the treatment.

DANGER OF INJURY TO THE FRUIT AND FOLIAGE.

If the self-boiled lime-sulphur is properly prepared and applied, there is very little danger of injuring the fruit or foliage. In all of our work during the past season not the slightest injury developed on any of the several thousand trees sprayed. During the season the writers examined several orchards, ranging from 200 to 500 acres, that had been sprayed by the owners with self-boiled lime-sulphur. No serious injury had resulted from the spraying in any of these orchards. Where injury occurred at all, it was only slight and was confined to a few dozen trees, except in one case where there was a general scorching of the foliage throughout the orchard, due, perhaps, to too much boiling of the mixture; but even in this case the result was only a slight thinning of the foliage, which was scarcely sufficient to damage the trees. In each case the mixture was so exceedingly successful as a fungicide that the owner did not consider the slight injury caused by it as worthy of consideration. However, of the thousands of orchards that will probably be sprayed with this mixture, there will doubtless occur from time to time cases of rather serious injury. Such cases in the opinion of the writers will be exceptional and will not be so common or so serious as is Bordeaux injury of the apple.

It was expected that where arsenate of lead was used in these experiments some injury might occur, but neither fruit nor foliage showed any signs of injury. In the first application of poison made when the dried calyces were shedding, no lime-sulphur was used, but in the second, three weeks later, the lime-sulphur mixture and arsenate of lead were used in combination. It seems barely possible that the lime-sulphur preparation may correct the tendency of the arsenate of lead to injure, although no definite evidence on this point has yet been obtained. In the experiments conducted at Marshallville, Ga., last year, peach foliage and fruit sprayed with the self-boiled wash and arsenate of lead combined were slightly injured,[a] but the notes on this work indicate that the injury was due mostly to the lime-sulphur wash, which was boiled too long in an effort to get a large amount of sulphur in solution. Some arsenate-of-lead injury will doubtless occur from time to time, but where the curculio is so bad, as in southern peach orchards, it would seem advisable for the owners to take some risk in the use of the poison to hold this insect in check.

DANGER OF STAINING THE FRUIT.

There is some danger of staining the fruit with the mixture if it is applied within two or three weeks of the ripening period. Mr. C. A. McCue,[b] of the Delaware experiment station, reported good results

[a] Circular 27, Bureau of Plant Industry, U. S. Dept. of Agriculture, pp. 6–7.

[b] Bulletin 85, Delaware Agricultural Experiment Station.

against brown-rot from the use of self-boiled lime-sulphur during 1908, but complained of marring the appearance of the fruit by heavy deposits of lime. The formula that he used (15 pounds of lime and 10 pounds of sulphur to 50 gallons of water) was stronger than necessary, and the spraying was perhaps continued too near the ripening period. In our 1907 experiments this heavy mixture was used and at picking time the fruit was somewhat stained, but the amount of lime used has since been reduced from 15 to 8 pounds in 50 gallons and the staining now is not a serious matter. The Chicago buyers who purchased the sprayed fruit of the orchard at Neoga, Ill., in which our 1908 experiments were conducted, made no complaint of staining, but on the contrary declined to purchase any of the unsprayed fruit on account of bad scab infections. The sprayed fruit of the Georgia experiments showed evidence of the mixture at picking time, but the whitish specks were largely rubbed off in picking, sorting, and packing. It was more highly colored, slightly larger, and presented a much better appearance than the unsprayed fruit. However, in order to avoid whitewashing the fruit, the last application should be made not later than about four weeks before the ripening period and care should be taken to give the peaches a uniformly light coating of fine spray.

RESULTS OBTAINED BY GROWERS IN COMMERCIAL ORCHARDS.

A considerable number of peach growers have already taken up the self-boiled lime-sulphur treatment for the control of scab and brown-rot, and the writers have been able to obtain reports from some of these. Stranahan Brothers, of Bullochville, Ga., were among the first to give it a trial on a commercial scale. In 1908 they sprayed their orchard of 35,000 trees twice with self-boiled lime-sulphur and arsenate of lead. In a letter dated January 13, 1909, they report that, aside from about 50 trees, the leaves of which were slightly burned, "not a leaf or peach was injured and we had no brown-rot and only one-half of 1 per cent of wormy peaches, including culls and drops. In fact, we had no drops, May, June, or otherwise, and had to thin the fruit three times." They sprayed the orchard again in 1909, using about the same treatment, and the junior writer made observations on the results at two different times during the season. It was found that considerable injury to foliage had occurred at several places in the orchard, due perhaps to too much cooking of certain lots, but in no case did this injury appear to be serious, certainly not sufficient to discourage spraying. Peach scab and brown-rot were almost completely controlled, as was the case the previous year.

Miller Brothers, of Okonoko, W. Va., were as quick to take up the treatment, and their work was directed more especially to the control

of peach scab. They sprayed their orchard of 600 acres in 1908 and again in 1909 and report that they obtained good results both seasons. In previous years the scab had been so bad that a large percentage of the crop was lost each year, and the owners considered the orchard unprofitable until the lime-sulphur treatment made possible the control of this disease without injury to the foliage.

During 1908 the Sleepy Creek Orchard Company, of Sleepy Creek, W. Va., sprayed their orchard of 15,000 peach trees from three to six weeks after the petals fell with 8 8–50 self-boiled lime-sulphur. A portion of the orchard was sprayed again a month later. Fortunately in this orchard trees were left unsprayed as checks and the difference between the sprayed and unsprayed fruit was so striking that the writers deemed it worth while to sort the fruit from several trees and obtain exact percentages of scab infections. From an Elberta tree sprayed twice there were 1,551 peaches, 15 per cent of which was slightly affected with scab and none badly scabbed. Another Elberta tree sprayed only once had 731 peaches, 44 per cent of which showed some scab spots, but only 1.3 per cent was badly scabbed. (See Pl. IV, fig. 1.) An unsprayed tree in the check block had 468 peaches, all of which were affected and 86 per cent badly scabbed. (See Pl. III, fig. 2, and Pl. IV, fig. 2.) These three trees selected for this count work were situated close together in a rather low place where the scab would naturally be bad. It will be observed that one spraying held the disease in check, so that only a little more than 1 per cent of the crop was badly affected, while 86 per cent of the unsprayed fruit came in this class. However, it would not be wise to conclude from this that one application is sufficient. It is shown that 44 per cent of the fruit sprayed once had some scab infections. The second application reduced this to 15 per cent, none of which was bad. In other words, all of the fruit from the trees sprayed twice was suitable for packing, and none of it had enough scab to attract attention; all but 1 per cent of the fruit from the trees sprayed once was suitable for packing, but had enough scab infections to detract somewhat from its appearance, while 86 per cent of the fruit from the unsprayed trees was entirely unsuited for the market and the remainder was sufficiently affected to decrease its market value.

COURSE OF TREATMENT RECOMMENDED.

Self-boiled lime-sulphur, when properly applied, will entirely control peach scab, and when the curculio does not interfere too seriously it will largely prevent brown-rot. In view of the fact that numerous brown-rot infections take place through curculio punctures, it would seem advisable, where the two troubles occur together, to use arsenate of lead in connection with the lime-sulphur mixture as a

combined remedy for both troubles. The fact that arsenate of lead sometimes injures both the fruit and the foliage of the peach is well known and should be borne in mind by the orchardist, but when the applications are made early in the season the danger of injury seems to be slight. Therefore, upon the advice of Mr. A. L. Quaintance, of the Bureau of Entomology, arsenate of lead is included in the course of treatment outlined below.

BROWN-ROT, SCAB, AND CURCULIO TREATMENT.[a]

For the Elberta, Belle, Reeves, and other varieties of peaches of about the same ripening season, the following is advised:

(1) About the time the calyces (or shucks) are shedding, spray with arsenate of lead at the rate of 2 pounds to 50 gallons of water. In order to reduce the caustic properties of the poison, add milk of lime made from slaking 2 pounds of stone lime. The date of this treatment is too early for scab and ordinarily no serious outbreaks of brown-rot occur so early, so that the lime-sulphur may be omitted with reasonable safety; but during warm rainy springs, especially in the South, the lime-sulphur will doubtless be necessary in this application.

(2) Two to three weeks later, or about one month after the petals drop, spray with 8–8–50 self-boiled lime-sulphur and 2 pounds of arsenate of lead.

(3) About one month before the fruit ripens spray with 8–8–50 self-boiled lime-sulphur, omitting the poison.

For earlier maturing varieties, such as Waddell, Carman, and Hiley, the first two treatments outlined above would probably be sufficient ordinarily, but in very wet seasons bad-rotting varieties would doubtless require three treatments. Late varieties, such as Smock and Salway, having a longer season, would not be thoroughly protected by three applications, but on account of the expense the writers dislike to recommend a fourth spraying. In view of the results obtained on mid-season varieties it seems likely that three treatments will ordinarily be sufficient for the late varieties.

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[a] The attention of the reader is called to the following statement by Mr. Quaintance regarding the use of arsenate of lead on the peach for the control of the curculio:

"The schedule of applications, arranged to effect a combination treatment for the plum curculio and brown-rot, represents a compromise as to the number of applications and times of spraying considered strictly from the curculio standpoint. Thus, were the control of the curculio the only consideration, the first application should be made within a week after the falling of the petals; the second about as the dried calyces, or "shucks," are being thrown off by the rapidly swelling fruit, and a third about two weeks later, though this latter treatment is attended with increased risk to the foliage and fruit.

"Of the several arsenical poisons, arsenate of lead should always be employed for stone fruits, especially the peach. There are now numerous brands of arsenate of lead on the market, and while most of these are carefully prepared and ordinarily free from dangerous by-products the grower should exercise care in the selection of a brand, purchasing only from reputable firms. Arsenical injury to peaches manifests itself by a shot-holing and dropping of the leaves and an excessive reddening and sometimes falling of the fruit as it approaches maturity. The extent of injury liable to result will depend upon weather conditions, and the number of applications given. Ordinarily, the risk from two applications of arsenate of lead, as outlined for use with the lime-sulphur mixture, will be inconsequential, and the orchardist can well afford to take the chances of injury in view of the great benefit derived in lessening brown-rot and in the control of the curculio itself."

BROWN-ROT AND SCAB TREATMENT.

In orchards where curculio is not troublesome, the arsenate of lead should be omitted. The treatment for brown-rot and scab on mid-season varieties would then be as follows:

(1) Three to four weeks after the petals fall spray with 8–8–50 self-boiled lime-sulphur.

(2) About three weeks later spray with the same mixture.

(3) About one month before the fruit is expected to ripen make another application of the same mixture.

SCAB TREATMENT.

For the treatment of scab alone, spray the trees with 8–8–50 self-boiled lime-sulphur about one month after the petals drop and again three to four weeks later.

One treatment thoroughly applied one month after the petals drop will so nearly control scab that in many cases a second spraying may not be necessary, but on account of the way spraying is ordinarily done two treatments will usually be required, especially on late varieties.

APPLICATION OF THE SPRAYING MIXTURES.

The necessity of keeping the mixtures thoroughly agitated while spraying can not be too strongly emphasized. Both self-boiled lime-sulphur and arsenate of lead settle readily, and if the spraying outfit is not equipped with a good agitator the mixture will not be evenly distributed and some of the trees will be oversprayed, while others will receive an insufficient application. In power sprayers the propeller type of agitator is the most satisfactory for this work. The early applications of lime-sulphur may be made rather heavy, but the last spraying should be made with fine nozzles, and the aim should be to give the fruit a uniform coating of a mist-like spray. Heavy drenching of the trees should be avoided.

PLATES.

DESCRIPTION OF PLATES.

PLATE I. Frontispiece. Peaches affected with brown-rot, showing the destructive work of the disease, the rotten, moldy appearance of affected peaches, and the gray tufts of spores produced by the fungus. This is a photograph of a pile of discarded Carman peaches in an orchard at Fort Valley, Ga.

PLATE II. Two crates of Elberta peaches picked from the experimental plats at Fort Valley, Ga., on July 9, 1909, shipped by refrigerator car to New York, and then by express to Washington, D. C., opened and photographed on July 16, a week after picking, showing the difference in the amount of brown-rot developed. The fruit on the left was from a sprayed plat, No. 6, and developed very little brown-rot, while that on the right was from an adjacent unsprayed plat and became badly affected with brown-rot in transit.

PLATE III. Peach scab. Fig. 1.—Two unsprayed Elberta peaches affected with scab, showing the black spots and cracks produced by the fungus. Fig. 2.—The crop of peaches from an unsprayed Elberta tree, showing the fruit badly affected with scab. All the fruit was affected and 86 per cent of it was so "smutty" and cracked as to be unfit for the market. This fruit was from one of the unsprayed trees in the orchard of the Sleepy Creek Orchard Company, at Sleepy Creek, W. Va.

PLATE IV. Peach scab. Fig. 1.—The crop of peaches from an Elberta tree sprayed once with self-boiled lime-sulphur. The good, merchantable fruit (98 per cent of the crop) is shown in the pile and the unmerchantable, scabby fruit on the notebook at the top. This fruit was grown in the same orchard as that shown in Plate III, figure 2. Fig. 2.—The same unsprayed crop shown in Plate III, figure 2, sorted for the market. The large pile of fruit on the right is unmerchantable on account of scab, that on the left representing all that was suitable or packing (only 14 per cent of the crop).

TWO CRATES OF ELBERTA PEACHES PICKED FROM THE EXPERIMENTAL PLATS AT FORT VALLEY, GA., ON JULY 9, 1909, SHIPPED BY REFRIGERATOR CAR TO NEW YORK, AND THEN BY EXPRESS TO WASHINGTON, D. C., SHOWING THE DIFFERENCE IN THE AMOUNT OF BROWN-ROT DEVELOPED.

The crates were opened and photographed on July 16. The fruit on the left had been sprayed, while that on the right had not been sprayed.

FIG. 1.—TWO UNSPRAYED ELBERTA PEACHES AFFECTED WITH SCAB, SHOWING THE BLACK SPOTS AND CRACKS PRODUCED BY THE DISEASE.

FIG. 2.—CROP FROM AN UNSPRAYED ELBERTA PEACH TREE, SHOWING ALL THE FRUIT AFFECTED WITH SCAB AND 86 PER CENT OF IT UNMERCHANTABLE. SLEEPY CREEK, W. VA., AUGUST 27, 1909.

FIG. 1.—CROP OF ELBERTA PEACHES FROM A TREE SPRAYED ONCE WITH SELF-BOILED LIME-SULPHUR. GOOD, MERCHANTABLE FRUIT IN THE PILE AND UNMERCHANTABLE, SCABBY FRUIT ON THE NOTEBOOK AT THE TOP. SLEEPY CREEK, W. VA., AUGUST 27, 1909.

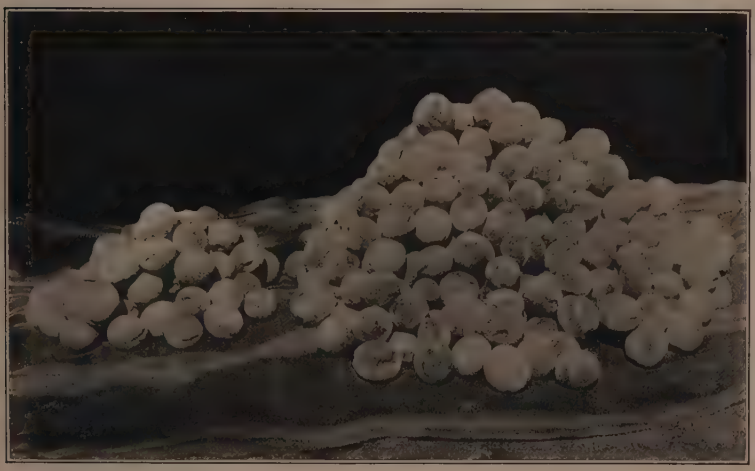

FIG. 2.—THE SAME UNSPRAYED CROP SHOWN IN PLATE III, FIGURE 2, SORTED FOR THE MARKET. THE LARGE PILE ON THE RIGHT IS UNMERCHANTABLE, SCABBY FRUIT, THAT ON THE LEFT REPRESENTING ALL THAT WAS SUITABLE FOR PACKING.

PEACH SCAB.

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